



2025 Center Award
Dr Mohammed H. Elnagar DDS, MS, PhD
University of Illinois, Chicago

Dr. Mohammed Elnagar is an Associate Professor in the Department of Orthodontics at the University of Illinois Chicago (UIC). He received his DDS, graduating with honors as class Valedictorian, followed by a General Practice Residency and a Master of Dental Science. Dr. Elnagar completed a Certificate of Specialty in Orthodontics and a PhD program in oral health sciences at the University of Illinois Chicago. He is a Diplomate of the American Board of Orthodontics. In 2022, he obtained a certificate in Artificial Intelligence (AI) applications in health care from the Massachusetts Institute of Technology (MIT).

Dr. Elnagar practices orthodontics in Chicago, focusing on Digital orthodontics, dentofacial orthopedics with skeletal anchorage, and surgical orthodontics. Furthermore, he is the Director of the digital and AI Laboratory at UIC Orthodontics; his Research Interests are 3D Imaging, 3D printing TADs, Artificial intelligence applications in Health Care, and Clinical and Transitional research. Dr. Elnagar received the Robert Ricketts Award, the Albert Westfall Award, and the Robert James Bray Biomedical Research Award from the American Association of Orthodontists Foundation (AAOF).

The American Association of Orthodontists (AAO) also appointed him to be the recipient of the AAO Academy of Academic Leadership Sponsorship Program Award for 2019. In addition, Dr. Elnagar was elected as secretary for the American Association for Dental Research Chicago section in 2020. And the Society of Educators of the American Association of Orthodontists editor in 2021. More recently, in 2023, for his work on emerging technologies, he received the Burstone-Indiana Biomechanics Award Designated as a Burstone Fellow in Biomechanics.

Dr Elnagar has published more than 40 articles and 5 book chapters; he gave more than 45 invited talks\lectures in at national and international meetings.

Project Synopsis

External Apical Root Resorption (EARR) is a well-recognized adverse outcome of orthodontic treatment, with severe cases (> 1/3 root loss) posing significant risks for long-term tooth retention and stability. Despite decades of research, clinicians still lack reliable tools to accurately predict which patients are at the highest risk before or during treatment. Existing studies are limited by small, homogeneous samples and analytical approaches that fail to capture the complex, multifactorial nature of EARR.

To address this gap, this multi-center Type 3 Center Award proposes to develop **novel, interpretable Artificial Intelligence (AI) and Machine Learning (ML) models** to predict the risk of severe EARR. We will build a federated **EARR Data Enclave** by collecting comprehensive retrospective diagnostic and treatment data from severe EARR cases and matched controls across three geographically diverse centers (UIC, University of Washington, and UNMC). The dataset will include multi-modal inputs such as CBCT and panoramic radiographs, STL files, clinical photographs, treatment notes, and biomechanical details.

By leveraging modern AI approaches—including deep learning for root morphology analysis and explainable ML algorithms—we aim to discover and validate key patient and treatment-related predictors of EARR. Our models will be trained and tested on a diverse, real-world dataset, addressing previous limitations of “data drift” and bias. A core objective is to produce **clinically deployable, transparent AI tools** that can help orthodontists estimate EARR risk and adjust treatment plans proactively to minimize harm. This project lays the groundwork for an evidence-based, AI-driven approach to **predicting, preventing, and managing EARR** — ultimately improving patient safety and treatment outcomes in orthodontics.

The funding from the AAOF is crucial for our project, to support our team, and to obtain primary data for Federal grant. Furthermore, it will assist in the development of my career as an Educator, Clinician, and Scientist.